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(54) Process for producing resin moldings having a concave-convex pattern on the surface

Verfahren zum Herstellen von Formteilen aus Kunststoff mit Reliefmustern auf der Oberfläche

Procédé de fabrication d'articles moulés en matière plastique comportant des reliefs

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Description

The present invention relates to a process for producing a resin molding having a concave-convex pattern on its surface, which may be a substrate for an optical recording medium or an original stamper plate.

Typical methods which have so far been used to make a substrate for an optical recording medium include the compression method, the 2P molding method which uses a photo-curable resin, and the extrusion molding method. Each of these methods uses a stamper prepared by electroforming. The method of preparing the stamper generally involves providing an original die having a concave-convex pattern on its surface, electroforming a film on the original die and peeling the electroformed film from the original die. A replicating die (i.e. a so-called replica) is prepared from an original die by dispensing onto the surface of the original die an uncured photocurable resin which will hereinafter be referred to as 2P (photopolymer) placing a glass or plastic substrate thereon, thereby spreading the 2P between the original die and the substrate, and curing the 2P.

Fig. 7 shows a conventional procedure for preparing an original stamper plate. Firstly an original die 1 which has a concave-convex pattern (not shown in the drawing) on its surface is fixed to a fixing plate 11, and a given amount of uncured 2P is dispensed on the surface of the original die 1 (Fig. 7A). Then a glass substrate 2 is placed thereon so as to spread the 2P over the entire interface between the original die 1 and the glass substrate 2. The 2P is then cured by irradiation through the glass substrate 2 with an ultraviolet beam 12 (Fig. 7B) then the cured 2P (10) is peeled off the original die 1 together with the glass substrate 2 to obtain an original stamper plate 17 as a replica (Fig. 7C).

The above mentioned conventional procedure suffers from a number of disadvantages. When the glass substrate 2 is placed onto the uncured 2P on the original die 1, or when the uncured 2P is spread between the original die 1 and the glass substrate 2, inclusion of bubbles may occur. When an excess uncured 2P is dispensed, protrusions (flashes) of the uncured 2P develop at the edges of the original die 1. Fig. 7C shows protrusions 16 of uncured 2P which have formed at the replica edges, and would become broken in succeeding steps. Broken pieces of the protrusions become attached to the pattern of the replica or to the edges of the original die and form projections of the original die when the original die is used again for forming a replica.

It would be possible to apply a peeling agent to the edges of the original die and the glass substrate, or to use a masking agent to remove flashes of cured 2P by peeling. However, there is a high degree of risk that the removed flashes may become attached to the pattern surface of the replica or original die and give rise to defects. Thus this procedure is not preferred.

In order to overcome these problems, Japanese Laid-Open Patent Application No. 61-213130 discloses the spreading of uncured 2P in a vacuum so as to reduce the inclusion of bubbles, and the provision of a leak-preventing wall for the uncured 2P at the outer peripheral edge to prevent protrusion of the 2P. However, when a leak-preventing wall is provided, it is necessary to provide precise control of the amount of uncured 2P which is dispensed. If the amount is insufficient, not all the desired regions of pattern may have a sufficient supply. Where an excessive amount is dispensed, the 2P can pass over the leak-preventing wall to form protrusions.

It is well known to prepare from a photocurable resin a substrate for an optical recording medium, particularly an optical disc substrate. In that case, the problems can arise of inclusion of bubbles into the photocurable resin, and the occurrence of defects or flashes due to the protrusion of uncured photocurable resin. For example Japanese Patent Publication No. 63-58698 discloses a process for producing a substrate for an optical recording medium, which comprises applying an ultraviolet curable resin circumferentially onto a transparent substrate, placing the transparent substrate in an inverted attitude over a stamper with a clearance therebetween, letting the transparent substrate pass down onto the stamper while maintaining the substrate and the stamper in an inclined state and spreading the ultraviolet curable resin along the interface therebetween by rolling, thereby preventing inclusion of bubbles in the ultraviolet curable resin. However, even the above process does not provide precise control of the region where the ultraviolet curable resin is spread. For example, where a protrusion of the resin from the edges is to be prevented, in order to securely supply the resin to the concave-convex pattern region on the stamper surface a concave-convex pattern region cannot be provided at the edges of a stamper. This makes the process inefficient.

EP-A-0308104 discloses a method for preparing a substrate for an information recording medium which has the features set out in the preamble to claim 1. The mold is used for casting and a liquid transparent resin is injected into the mold by conventional casting methods and is then solidified.

EP-A-0327192 discloses that mold cavities can be filled with a liquid resin which is substantially free from trapped gas bubbles, and the development of flash and other irregularities at the peripheral edge of the polymer can be avoided by injecting resin into a mold cavity while the said mold cavity is evacuated, and allowing the resin to cure within the mold cavity. However, in this reference the mold cavities and the resin container are separate, and are connected to one another by means of pipes.

In one aspect the invention provides a process for producing a resin molding having the features set out in claim 1 of the accompanying claims. In a further aspect the invention provides a process as set out in claim 1, when used to make a stamper plate.

In a third aspect the invention provides an apparatus for producing a resin molding as set out in claim 30 of the accompanying claims.

How the invention may be put into effect will now be described, by way of example only, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B show one example of a cell shape for use in the present process for producing an original stamper plate, where Fig. 1A is a plan view of a cell and Fig. 1B is a cross-sectional view along the line A - A of Fig. 1A.

Figs. 2A and 2B show another example of a cell shape for use in the present process for producing an original stamper plate, where Fig. 2A is a plan view of a cell and Fig. 2B is a cross-sectional view along the line B - B of Fig. 2A.

Figs. 3A and 3B are views for explaining steps of filling uncured 2P into a cavity.

Figs. 4A to 4D show one embodiment of steps from filling uncured 2P into a cavity as far as production of an original stamper plate.

Figs. 5A to 5C show another embodiment of steps from filling uncured 2P into a cavity as far as production of an original stamper plate.

Figs. 6A and 6B are views for explaining a procedure for filling uncured 2P into a cavity according to Example 1.

Figs. 7A to 7C show steps for producing an original stamper plate by a conventional dispense-spread procedure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be explained in detail below, referring to the drawings.

Figs. 1A and 1B show one example of a cell shape for use in the present process for producing an original stamper plate, where Fig. 1A is a plan view of a cell and Fig. 1B is a cross-sectional view along the line A - A of Fig. 1A.

As shown in Figs. 1A and 1B, an original die 1 having a concave-convex pattern 1′, such as pits, grooves, etc. on the surface and a glass substrate 2 having a flat surface are counterposed through a spacer 3 having a given thickness provided at the outer periphery so that the concave-convex pattern surface and the flat surface can face each other, and a cell 4 having a cavity 17 surrounded by the original die 1, the substrate 2 and the spacer 3 is formed thereby. An inlet 5 for filling uncured 2P into the cavity 17 is provided at a position of the outer periphery of the cell 4.

Figs. 2A and 2B show another example of a cell shape for use in the present process for producing an original stamper plate, where Fig. 2A is a plan view of a cell and Fig. 2B is a cross-sectional view along the line B - B of Fig. 1A.

As shown in Figs. 2A and 2B, an inlet 5′ is provided on a glass substrate 2 as an opening, through which uncured 2P may be filled into a cavity 17. The inlet 5′ can be also provided on the original die 1, so long as the outlet 5′ is positioned outside the effective area.

The present process for producing an original stamper plate, using the cell as described above, will be explained below.

As shown in Fig. 3A, the cell 4 formed by the original die and the glass substrate and uncured 2P (9) are placed in a chamber 6, and air is evacuated from the chamber 6 through a vent 7 to keep the inside of the chamber 6 in a vacuum state. After deareation of uncured 2P (9) in the chamber 6 is completed, the vent 7 is closed and the inlet 5 of the cell 4 is dipped into the uncured 2P (9), as shown in Fig. 3B and air is leaked in from an air inlet 8. Through the foregoing operations, uncured 2P (9) is gradually introduced into the cell 4 due to a pressure difference between the cell 4 and the chamber 6. To promote the introduction of uncured 2P (9) into the cell 4, it is possible to make the pressure in the chamber 6 higher than the atmospheric pressure, that is, to pressurize the chamber 6.

In the present invention, it is preferable in the introduction of uncured 2P into the cavity 17 that the internal pressure of the cavity 17 is $1/10^2$ to $1/10^4$, particularly $1/10^2$ to $1/10^3$ of the external pressure. That is, when the internal pressure and the external pressure of the cavity 17 are set to have an above-mentioned relationship, uncured 2P (9) can be securely filled up to the ends of the cavity 17 without any large deformation of the cavity shape, and the rate of uncured 2P (9) to be introduced into the cavity 17 can be appropriately controlled.

When the pressure of the chamber 6 is made higher than the atmospheric pressure, as mentioned above, it is preferable to pressurize the chamber 6 so that a relationship between the internal pressure and the external pressure of the cavity 17 can be in the above-mentioned range.

In order to prevent inclusion of bubbles into 2P (9), it is preferable in the present invention that the cavity 17 has a vacuum degree of not more than 1 Torr, particularly not more than 0.1 Torr as an internal pressure.

After the introduction of uncured 2P (9) into the cell 4 has been completed, the uncured 2P (9) in the cell 4 is irradiated with an ultraviolet (UV) beam to cure 2P, as shown in Figs. 4A and 4B, and then the original die 1 is peeled off the glass substrate 2, whereby an original stamper plate comprising the glass plate 2 and a replical θ formed on the glass substrate 2 can be obtained (Figs. 4C and 4D).

As explained above, uncured 2P is introduced into the cavity 17 due to a pressure difference between the internal pressure and the external pressure of the cavity 17 attained by evacuating the cavity 17 to bring the internal pressure into vacuum according to the present process for producing a replica, and thus no inclusion of bubbles takes place in a molding. In the present invention there is no such a necessity for dispensing 2P, followed by lamination and spreading as in the prior art. Still furthermore, the resin can be securely filled up to the ends

of the surface of the original die 1, and a concave-convex pattern can be formed even at the edge parts of the surface of the original die 1. That is, the original die can be fully utilized in the present invention.

In the present invention, only a spacer is provided at the outer periphery portion of the original die and thus a replica of any shape can be produced. In the preparation of substrates, it is advantageous from the viewpoint of efficiency and cost to produce a stamper as large as possible and obtain a number of substrates by one run. In the present invention, it is possible to produce a number of original stamper plates by one run.

Optical recording media include a circular shape and a rectangular shape such as a disc form and a card form, and particularly in case of a card, a rectangular stamper can produce a number of substrates by one run very efficiently with advantage.

In the present invention, the spacer 3 must have a function to make a cavity thickness of the cell 4, i.e., a gap constant, and a function to intercept air to form a pressure difference between the inside and the outside of the cell 4, i.e., a sealing function.

Materials for the spacer 3 are not particularly limited, so far as they can give the spacer a sealing function and a function to keep the cavity thickness uniform, but it is preferable to use a polymerizable component, which can be polymerized by light irradiation and/or by heating or polymerizable at ordinary temperature as spacer materials, because sealing of the original die 1 and the substrate 2 or formation of a spacer at the assembling of the cell 4 can be readily carried out by a dispersing procedure. For example, it is preferable to use polymerizable components including oligomers and/or monomers of acrylic, silicone, polyester, epoxy and urethane resins as a spacer material.

It is also possible to add a gap-forming agent to the spacer material to improve the uniformity of the thickness of the cavity 17. Such a gap-forming agent preferably has a predetermined outer diameter, and includes inorganic or organic fine particles such as alumina beads, zirconia beads, polystyrene beads, microballoons, etc. whiskers having a predetermined size can be also used.

When the gap-forming agent is used together with the spacer material, it is preferable from the viewpoint of dispersibility of the gap-forming agent and easiness of dispensing to use the above-mentioned polymerizable component, which can be polymerized by light irradiation and/or by heating, or polymerizable at ordinary temperature, as a spacer material. That is, a cell 4 can be formed with those polymerizable components as a spacer material by adding, if necessary, a gap-forming agent having a predetermined diameter to the polymerizable component such as an uncured oligomer and/or monomer, which is polymerizable by light irradiation and/or by heating; dispensing a given amount of the resulting mixture of the spacer material and the gap-forming agent onto the outer periphery of an original die 1 or a substrate 2; placing the original die 1 over the substrate 2 with such a clearance as to provide a given thickness to the cavity 17; and polymerizing the polymerizable component, thereby solidifying the polymerizable component.

As a spacer 3, a film molded to a predetermined thickness can be also used.

As a spacer film, a metallic film such as an aluminum foil or a plastic film can be used. It is preferable from the viewpoint of adhesiveness, i.e., sealability of the original die 1 and the glass substrate 2 to use a plastic film.

Applicable plastic films include films of, for example, polyethylene, polypropylene, polyvinyl alcohol, polyethylene terephthalate, polyacetyl cellulose, polyamide, polyimide, etc. By selecting an appropriate thickness of the plastic film, the gap degree of the cavity 17 can be controlled, and the desired sealability can be obtained thereby. As shown in Fig. 4D, the spacer 3 is ultimately removed, and a replica 10 is formed on the substrate 1. In case of using a film as the spacer 3, its removed is much simpler.

In the present invention it is preferable that the spacer is an elastomer having a hardness of not more than 80, particularly not more than 50 according to ASTM D 2240 (JIS K 6301). In the conventional curing of the uncured resin in the cavity, volumic shrinkage takes place when the liquid phase changes into a solid phase, and thus peeling of the cured resin from the outer periphery of the original die 1 due to the shrinkage in the thickess direction, that is, the so-called "floating" takes place, or a shrinkage in the in-plane direction of the cell 4, that is, the so-called "retraction" appears, resulting in uneven thickness of moldings or crack formation on the moldings. When the hardness of the spacer is limited to the above-mentioned range, occurrence of the "floating" or "retraction" can be reduced when the uncured prepolymer is cured. Such a preferable spacer material includes a polymerizable silicone rubber which is polymerizable by light irradiation and/or by heating.

In the present invention, it is very effective to use a gel-state elastomer having a penetration of 10 to 100, particularly 30 to 100, according to ASTM D 1321 as a spacer material. When a gel-state elastomer is used as a spacer material, as mentioned above, occurrence of "floating" or "retraction" of moldings can be well reduced and the cell can be prevented from a large deformation due to a flow when the inside of the cavity is brought into a negative pressure.

A good restoration to the predetermined cavity dimensions can be obtained by filling uncured 2P into the cavity of defomred cell due to the negative pressure prevailing in the cavity, and the thickness of moldings can be prevented from unevenness.

Materials for the gel-state elastomer includes, for example, silicone rubbers, which turn to gel-state elastomers by light irradiation and/or by heating or by curing at ordinary temperature, such as YE 5822, YE 5818, TSE 3051 and TSE 3051L, (trademarks of products made by Toshiba Silicone K.K., Japan), which act as a spacer when applied to the surface of an original die or a sub-

strate at the time of cell assembling and are readily missible with a gap-forming agent.

It is also effective to add fine hollow particles or microspheres capable of compression deformation as a gap-forming agent to the spacer of elastomer. However, the gap-forming agent is not always necessary to use, and it is preferable to provide only the elastomer at the outer periphery.

The spacer composed only of elastomer can be effectively formed, for example, by providing a gap-forming agent at the outer periphery of an original die, dispensing a prepolymer of the elastomer at the inside of the gap-forming agent, placing a glass substrate on the original die to make a laminate, curing the polymerizable component of the elastomer at first, then introducing uncured 2P into the cavity, and removing the gap-forming agent therefrom before curing the 2P, whereby the spacer only of the elastomer can be made present at the curing of the 2P. In that case, a preferable gap-forming agent is a film from the viewpoint of easy removal.

As another procedure for preventing "floating" or "retraction", a heat-softening material is used as a spacer material, and the curing of 2P is carried out in a softened state of the spacer while maintaining the cell at a higher temperature than the softening temperature of the spacer 3, whereby "floating" or "retraction" can be prevented.

Heat-softening materials for use in the present invention include, for example, resins such as polyolefin resin, polyamide resin, polyester resin, polyurethane resin, polyacrylic resin, polyvinyl chloride resin, polyvinyl resin, petroleum resin, polystyrene resin, polyvinyl acetate resin, and cellulose resin; elastomers such as natural rubber, styrene-butadiene rubber, isoprene rubber and chloroprene rubber; and natural and synthetic waves such as spermaceti, beeswax, lanolin, carnauba wax, candelilla wax, montan wax, ceresine wax, paraffin wax, microcrystalline wax, oxidized wax, amide wax, ester wax, Fischer-Tropsch wax, stearyl alcohol, and sorbitan fatty, acid ester.

From the viewpoint of easy workability and easy handling, preferable softening temperature of the heat-softening material is usually 40° to 150°C, particularly 50° to 120°C.

Melt viscosity of the heat-softening material is preferably higher than that of uncured 2P to be used at a temperature by 10°C higher than the softening temperature of the heat-softening material, and is usually 10 to 10^5 cps, particularly 20 to 10^4 cps. Below 10 cps, uncured 2P is liable to protrude, whereas above 10^5 cps, peeling or retraction is liable to occur.

The above-mentioned resins, elastomers and waxes can be used alone as the spacer 3 or in an appropriate combination thereof as the heat-softening material to adjust the softening temperature or the melt viscosity. Above all, the waxes are preferable heat-softening materials because the viscosity of the waxes are abruptly lowered above the softening temperature and are easy to peel off the original die 1 after the curing of 2P and have a desired softening temperature and melt viscosity as mentioned above.

Even if the spacer is not made of an elastomer, spacer 3 is removed after the uncured 2P is introduced into the cavity but before the uncured 2P is cured, as shown in Figs. 5A to 5C, and then the 2P is cured, whereby occurrence of "floating" or "retraction" can be prevented. When there is a fear of protrusion of uncured 2P to the outside of the cavity 17 due to the removal of the spacer 3 in that case, the entire cell is cooled to increase the viscosity of the uncured 2P thereby to prevent the protrusion of uncured 2P. It is simple and advantageous from the viewpoint of removal of the spacer before the curing of uncured 2P to use a film spacer.

The clearance of cavity 17 of the present cell 4 is set in accordance to the thickness of moldings to be produced, and is in a range of 5 to 500 µm, preferably 10 to 300 µm, more preferably 15 to 200 µm. When the thickness of the cavity 17 is less than 5 µm, the flatness of the original die and the substrate must be maintained with a higher exactness, and the original die and the substrate will be bent in the inward direction to the cavity 17 due to the introduction of uncured 2P into the cavity 17 by the pressure difference and may be brought into contact with each other at the center of the cavity 17, resulting in incomplete introduction of the prepolymer.

The present invention is not limited only to the production of original stamper plates, but is also applicable to the production of substrates for optical recording media such as optical cards or optical discs. In that case, the resin moldings themselves can serve as substrates for optical recording media. The substrates for optical recording media can be prepared by curing the prepolymer in the cavity and peeling the cured polymer from the original die and the substrate. As shown in Fig. 4D, the resin molding and the substrate may be integrated together to provide a substrate for optical recording media.

In the foregoing, uncured photocurable resin has been explained as materials to be filled in the cavity 17. In the present invention, any material can be used without any restriction, so far as it can be filled into the cavity as a liquid and then can be cured. For example, photopolymerizable monomers, heat-polymerizable oligomers and/or monomers, or prepolymers, or liquid polymers dissolved in a solvent, etc. can be used. Among these materials, those having a volume shrinkage of not more than 10%, particularly not more than 5%, more particularly not more than 3%, are preferable materials in the present invention.

When any one of the above-mentioned materials is filled as a liquid filled into the cavity 17, it is preferable that such a material has a viscosity of not more than 10^4 cps, particularly not more than 10^2 to 10^3 cps according to JIS K 7117 when it is filled into the cavity 17. When the above-mentioned photopolymerizable monomers, heat-polymerizable oligomers and/or monomers or prepolymers are used, it is also very effective to use a spacer of the above-mentioned elastomer.

The size of the cavity for use in the present invention is as follows:

In case that the cavity plan shapes are rectangular including, a square, it is preferable to set the diagonal distance to not more than 800 mm, particularly not more than 750 mm. In case that the cavity plan shapes are circular, it is preferable to set the diameter to not more than 800 mm, particularly not more than 750 mm.

As explained above, a cell is formed from an original die and a glass substrate, placed one upon another through a spacer and at least one of polymerizable prepolymers, monomers and liquid resins is introduced into the cavity of the cell due to a pressure difference between the internal pressure and the external pressure of the cavity in the present invention, and thus inclusion of bubbles into the resin moldings can be prevented without formation of resin flashes. That is, resin moldings of good quality can be obtained according to the present invention.

Furthermore, any cavity shape can be selected and thus a replica of any shape can be prepared. Since the liquid polymeriable prepolymers and/or monomers or liquid resin can be securely filled up to the ends of the cavity 17, a concave-convex pattern can be formed on the entire surface of the original die and efficient resin molding can be carried out in the present invention. Still furthermore, good resin moldings with a uniform thickness and without any cracks, etc. can be obtained with a gel-state elastomer as a spacer for the cell 4.

The present invention will be explained in detail below, referring to Examples.

Example 1

A 5 wt.% dispersion of microspheres having an average particle size of 40 μm (Expancel DU, trademark of a product made by Nihon Ferrite K.K., Japan) in photocurable resin (Hardlock OP4515, trademark of a product made by Denki Kagaku Kogyo K.K., Japan) was dispersed as a spacer at the outer periphery of a square original die, 300 mm x 300 mm, with a pattern area, 250 mm x 250 mm, by a dispenser, and then a glass substrate, 340 mm x 340 mm, with an inlet was placed thereon, as shown in Figs. 2A and 2B. The photocurable resin was irradiated with ultraviolet beam to cure the resin, whereby a cell with an effective area of 270 mm x 270 mm was obtained.

The pattern formed in the pattern area of the original die was a pattern corresponding to pregrooves for a stripe-shaped optical card, 3 μm wide, 12 μm for pitch and 3,000 Å deep.

Then, a photo-curable resin (2P) was filled into the cavity 17 according to a procedure shown in Figs. 6A and 6B. At first, as shown in Fig. 6A, the inlet 5 of the cell was connected to a funnel 14 through a Teflon® tube 13 and then the cell was placed in a vacuum chamber. Another funnel 14' was so provided as to supply 2P (INC 118, trademark of a product made by Nihon Kayaku K.K., Japan) dropwise to the funnel 14, and the funnel 14' was made to open or close by an electromagnetic valve 15 by manipulation from the outside of the vacuum chamber.

Then, the air of the vacuum chamber was evacuated to reduce the internal pressure of the cavity 17 to 0.1 Torr. The vacuum chamber was kept at that vacuum degree for 30 minutes to remove bubbles from the 2P. Then, as shown in Fig. 6B, the electromagnetic valve 15 was opened to supply 2P into the funnel 14 dropwise and then air was gradually leaked into the chamber 6. 8 hours after the start of air leakage, the vacuum chamber was returned to the atmospheric pressure and 2P was fully introduced into the cell. It was observed by visual inspection that there were no bubbles in the cell.

In this Example, an acrylic ultraviolet-curable resin having a viscosity of 700 cps in the uncured state and a volume shrinkage of 3% after curing was used as 2P.

Then, the Teflon tube was removed from the inlet of the cell and the cell was irradiated with an ultraviolet beam from the glass substrate side to cure the 2P. It was found by visual inspection that floatings of maximum width of 10 mm occured without any retraction. Then, the original die and the glass substrate were parted off, whereby an original stamper plate for an optical card provided with a replica, 250 mm x 250 mm, of extactly transferred concave-convex pattern of the original die on the glass substrate was obtained.

Example 2

A cell was formed in the same manner as in Example 1 except that a polyethylene terephthalate film having a thickness of 50 μm was used as the spacer. After the spacer-inserted part was thoroughly clamped for sealing, 2P was introduced into the cell and subjected to photocuring in the same manner as in Example 1. No bubbles were observed in the cell. After the photocuring, floatings occurred at the spacer periphery, but no retraction was observed. By peeling the original die off, an original stamper plate for an optical card, provided with a replica, 250 mm x 250 mm and 50 μm thick, of exactly transferred concave-convex pattern of the original die on the glass substrate was obtained.

Example 3

A polyethylene terephthalate (PET) film, 5 mm wide and 50 μm thick, was provided at the outer periphery of the same original die as used in Example 1, and then a liquid ultraviolet-curable silicone rubber (TFC 7870, trademark of a product made by Toshiba Silicone K.K., Japan) was dispensed at the inside of the film, and then a glass substrate having a mirror-polished surface was placed thereon so that the mirror-polished surface can face the patterend surface of the original die. Then, the silicone rubber was cured by irradiation with an ultraviolet beam to make a spacer having a hardness of 25 according to ASTM D 2240 and setting the gap degree of the cavity 17 to 50 μm.

Then, the PET film that sets the gap degree of the cavity was removed to form a cell sealed with the silicone rubber with a gap degree of cavity of 50 µm and a cell effective area of 270 mm x 270 mm.

2P was introduced into the cell, and subjected to photocuring and peeling in the same manner as in Example 1. No bubbles were observed in the filled cell and no substantial floatings were observed at the periphery of silicone rubber after the photocuring. By peeling the original die off, an original stamper plate for an optical card, provided with a replica, 250 mm x 250 mm, of exactly transferred concave-convex pattern of the original die on the glass substrate was obtained.

Example 4

A cell was prepared in the same manner as in Example 3, except that ultraviolet-curable silicone rubber having a hardness of 17 after the curing according to ASTM D 2240 (XE-303, trademark of a product made by Toshiba Silicone K.K., Japan) was used in place of the ultraviolet-curable silicone rubber of Example 3, and a replica was molded from the cell in the same manner as in Example 3. No inclusion of bubbles in the replica was observed and no substantial floatings were observed at the periphery of the spacer. By peeling the original die off, an original stamper plate for an optical card, provided with a replica, 250 mm x 250 mm and 50 µm thick, of exactly transferred concave-convex pattern of the original die on the glass substrate was obtained.

Example 5

A cell was prepared in the same manner as in Example 3 except that an original die with an enlarged pattern area of 270 mm x 270 mm of Example 1 was used and gel-state ultraviolet-curable silicone having a penetration of 80 after the curing (XE · 17-A0884, trademark of a product made by Toshiba Silicone K.K., Japan) was used as a spacer in place of the ultraviolet-curable silicone rubber of Example 3.

A replica was molded from the cell in the same manner as in Example 3. The PET film that sets the gap degree was removed before 2P was introduced into the cavity. After filling of uncured 2P into the cavity, 2P was cured by irradiation with an ultraviolet beam. No floating from the original die was observed at all. The effective area of the replica after the peeling was 270 mm x 270 mm, which was equal to the cell effective area and the thickness of the replica was uniformly 50 µm throughout the entire surface.

Example 6

A cell was prepared in the same manner as in Example 5 except that gel-state ultraviolet-curable liquid silicone having a penetration of 85 after the curing (TUV 6001, trademark of a product made by Toshiba Silicone K.K., Japan) was used in place of the gel-state ultraviolet-curable liquid silicone of Example 5. A replica was molded from the cell and no occurrence of "floatings" and "retraction" was observed at all. By peeling the original die off, a replica of exactly transferred concave-convex pattern of the original die and uniform thickness over the entire surface of 270 mm x 270 mm was obtained.

Example 7

A cell was prepared in the same manner as in Example 2, except that a polyolefin film sheet (X-1430, trademark of a product made by Daicel K.K., Japan) having a thickness 50 µm was used in place of the spacer of Example 2, and the original die and the glass substrate were pressed to each other in a dry oven at 100 °C.

Then, 2P was introduced into the cavity and the 2P-filled cell was irradiated with an ultraviolet beam while maintaining the cell at 120°C to cure the 2P.

After the curing, some floating from the original die was observed near the spacer, and a replica, 260 mm x 260 mm, without inclusion of bubbles was obtained.

Example 8

A PET film, 5 mm wide and 50 µm thick, was provided at the periphery of the same original die as used in Example 1, and paraffin wax having a melting point of 155°F (68.3°C), made by Nihon Seiro K.K., Japan, was dispensed in a heated and molten state at the inside of the film, and a glass substrate was placed thereon. After the paraffin wax was solidified, the PET film was removed therefrom to form a cell, 270 mm x 270 mm.

Then, 2P was introduced into the cavity and the cell was irradiated with an ultraviolet beam while maintaining the entire cell at 80°C to cure the 2P. Even after cooling to room temperature, no floating of cured 2P from the original die was observed at all. By peeling the original die, a replica, 270 mm x 270 mm, without inclusion of bubbles was obtained. The paraffin wax had a melt index (78.3°C) of not more than 100 cps.

Example 9

A replica was molded in the same manner as in Example 8 except that lanolin wax (Lanox FP-1406N, trademark of a product made by Yoshikawa Seiyu K.K., Japan) was used in place of the paraffin wax of Example 8. After curing of 2P, a replica, 270 mm x 270 mm, without occurrence of floating and inclusion of bubbles was obtained. The lanolin wax had a melt index (80°C) of not more than 200 cps.

Claims

1. A process for producing a resin molding having a concave-convex pattern on the surface, which comprises:

(a) providing an original die (1) having a concave-convex pattern (1') on the surface and a substrate (4) having a flat surface, positioning the concave-convex pattern surface and the flat surface opposite to each other at a separation defined by a spacer (3), thereby forming a cell (4) with a cavity (17) formed by the original die, the substrate and the spacer,

(b) filling the cavity (17) with at least one of a liquid polymerisable component and the liquid resin,

(c) curing at least one of the liquid polymerisable component and the liquid resin in the cavity (17), so as to form a replica of the pattern (1'), and

(d) peeling the original die (1) from the replica, so as to obtain a resin molding, characterised in that

(e) said step of filling the cavity (17) with at least one of the liquid polymerisable component and the liquid resin is carried out by disposing the cell (4) and at least one of the liquid polymerisable component and the liquid resin within a chamber (6) having means (7, 8) for controlling the internal pressure,

(f) after reducing the internal pressure in the chamber (6), stopping up an inlet (5) of the cell with at least one of the uncured, liquid polymerisable component and the uncured, liquid resin, and then

(g) allowing the pressure in the inside of the chamber (6) to rise.

2. A process according to claim 1, wherein in the step (f) the internal pressure of the cavity is set to $1/10^2$ to $1/10^4$ of the external pressure.

3. A process according to claim 2, wherein in the step (f) the internal pressure of the cavity is set to $1/10^2$ to $1/10^3$ of the external pressure.

4. A process according to claim 1, wherein in the step (f) the internal pressure of the cavity is not more than 1 Torr.

5. A process according to claim 4, wherein in the step (f) the internal pressure of the cavity is not more than 0.1 Torr.

6. A process according to any preceding claim, wherein at least one of the liquid polymerisable component and the liquid resin to be filled in the cavity has a viscosity of not more than 10^4 cps.

7. A process according to claim 6, wherein at least one of the liquid polymerisable component and the liquid resin has a viscosity of 10^2 to 10^3 cps.

8. A process according to claim 6 or 7, wherein the liquid polymerisable component is an uncured photocurable resin.

9. A process according to any preceding claim, wherein at least one of the liquid polymerisable component and the liquid resin has a volume shrinkage of not more than 10% after curing.

10. A process according to any preceding claim, which includes the steps of using a material containing a liquid polymerisable component as a spacer material, applying uncured spacer material to the surface of at least one of the original die and the substrate, then placing the original die and the substrate one upon another and curing the spacer material, thereby forming a cell with the cured spacer material as the spacer.

11. A process according to claim 1, wherein an elastomer is used as the spacer (3) for the cell.

12. A process according to claim 11, wherein the elastomer has a hardness of not more than 80 determined by ASTM D2240 (JIS K6301).

13. A process according to claim 12, wherein the elastomer has a hardness of not more than 50.

14. A process according to claim 11 or 12, wherein the elastomer is a cured product of a material containing a liquid polymerisable component.

15. A process according to any of claims 11-14, wherein the elastomer is a silicone rubber.

16. A process according to any of claims 1-10, wherein a gel-state elastomer is used as the spacer for the cell.

17. A process according to claim 16, wherein the gel-state elastomer has a penetration of 10 to 100×10^{-1} mm.

18. A process according to claim 17, wherein the gel-state elastomer has a penetration of 30 to 100×10^{-1} mm.

19. A process according to claim 16, 17 or 18, wherein the gel-state elastomer is a cured product of a material containing a liquid polymerisable component.

20. A process according to claim 16, 17 or 18, wherein the gel-state elastomer is a silicone rubber.

21. A process according to any of claims 1-10, which has a step of using a heat-softening material as the spacer, filling the cavity of the cell with at least one of the liquid polymerisable component and the liquid

resin and curing at least one of the polymerisable component and the liquid resin in the cavity in a softened state of the spacer attained by heating the spacer to a temperature higher than the softening temperature of the spacer.

22. A process according to claim 21, wherein the heat-softening material is a material having a lower viscosity, at a temperature by 10°C higher than the softening temperature of the material, than the viscosity of at least one of the liquid polymerisable component and the liquid resin.

23. A process according to claim 21 or 22, wherein the heat-softening material is wax.

24. A process according to any preceding claim, which comprises the step of removing the spacer after the cavity has been filled with at least one of the liquid polymerisable component and the liquid resin and then the at least one of the liquid polymerisable component and the liquid resin in the cavity have been cured.

25. A process according to any of claims 1-9, wherein the spacer is a resin film.

26. A process according to any preceding claim, wherein the resin molding having a concave-convex pattern is a substrate for optical recording media.

27. A process according to any preceding claim, when used to make an original stamper plate from an original die having on its surface a concave-convex pattern for said stamper plate.

28. The process of claim 27, wherein the stamper plate is disk-shaped.

29. The process of claim 27, wherein the stamper plate is card-shaped.

30. An apparatus for producing a resin molding which comprises:

a cell with a cavity formed by an original die having a concave-convex pattern on the surface, a substrate having a flat surface and a spacer, the concave-convex pattern surface and the flat surface being held in opposite facing relationship through the spacer,

means of filling at least one of a liquid polymerisable component and a liquid resin into the cavity, characterised in that

said means of filling at least one of the liquid polymerisable component and the liquid resin into the cavity comprises a chamber in which the cell and said liquids are disposed,

means is provided for reducing the pressure in the interior of the chamber,

means is provided for stopping up an inlet of the cell with at least one of said liquids, and means is provided for releasing a reduced pressure state in the inside of the chamber.

31. An apparatus according to claim 30, wherein the spacer is an elastomer.

32. An apparatus according to claim 31, wherein the elastomer has a hardness of not more than 80 determined by ASTM D2240 (JIS K6301).

33. An apparatus according to claim 31 or 32, wherein the elastomer is a silicone rubber.

34. An apparatus according to claim 30, wherein the spacer is a gel-state elastomer.

35. An apparatus according to claim 34, wherein the gel-state elastomer has a penetration of 10 to 100 x 10^{-1} mm.

36. An apparatus according to claim 34 or 35, wherein the gel-state elastomer is a silicone rubber.

Patentansprüche

1. Verfahren zur Herstellung eines Harzformteiles mit einem konkav-konvexen Muster auf der Oberfläche, das folgende Schritte umfaßt:

(a) Bereitstellen eines Originalstempels (1) mit einem konkav-konvexen Muster (1') auf der Oberfläche und eines Trägers (4) mit einer flachen Oberfläche, wobei die Oberfläche mit einem konkav-konvexen Muster und die flache Oberfläche einander gegenüber in einer Entfernung voneinander, die durch einen Abstandshalter (3) festgelegt ist, angeordnet werden, wodurch sie eine Zelle (4) mit einer Höhlung (17) bilden, die durch den Originalstempel, den Träger und den Abstandshalter gebildet wird,

(b) Befüllen der Höhlung (17) mit wenigstens einem Material, ausgewählt aus der Gruppe, bestehend aus einer flüssigen, polymerisierbaren Komponente und dem flüssigen Harz,

(c) Härten des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, in der Höhlung (17), so daß eine Kopie beziehungsweise ein Replikat des Musters (1') gebildet wird, und

(d) Abschälen des Originalstempels (1) vom Replikat, wodurch ein Harzformstück erhalten wird,

wobei das Verfahren dadurch gekennzeichnet ist, daß

(e) der Schritt des Befüllens der Höhlung (17) mit dem wenigstens einen Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, durch Einbringen der Zelle (4) und des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, in eine Kammer (6) mit Einrichtungen (7 und 8) zum Steuern des inneren Druckes durchgeführt wird,

(f) Versperren einer Einlaßöffnung (5) der Zelle nach Verringern des inneren Druckes in der Kammer (6) mit dem wenigstens einen Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, und dann

(g) Steigenlassen des Druckes im Inneren der Kammer (6).

2. Verfahren nach Anspruch 1, worin im Schritt (f) der innere Druck der Höhlung auf $1/10^2$ bis $1/10^4$ des äußeren Druckes eingestellt wird.

3. Verfahren nach Anspruch 2, worin im Schritt (f) der innere Druck der Höhlung auf $1/10^2$ bis $1/10^3$ des äußeren Druckes eingestellt wird.

4. Verfahren nach Anspruch 1, worin im Schritt (f) der innere Druck der Höhlung nicht mehr als 1 Torr beträgt.

5. Verfahren nach Anspruch 4 , worin im Schritt (f) der innere Druck der Höhlung nicht mehr als 0,1 Torr beträgt.

6. Verfahren nach einem der vorhergehenden Ansprüche, worin das wenigstens eine Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, das in die Höhlung gefüllt werden soll, eine Viskosität von nicht mehr als 10^4 cps besitzt.

7. Verfahren nach Anspruch 6, worin das wenigstens eine Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, das in die Höhlung gefüllt werden soll, eine Viskosität von 10^2 bis 10^3 cps.

8. Verfahren nach Anspruch 6 oder Anspruch 7, worin die flüssige polymerisierbare Komponente ein ungehärtetes, lichthärtbares Harz ist.

9. Verfahren nach einem der vorhergehenden Ansprüche, worin das wenigstens eine Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, eine Volumenschrumpfung von nicht mehr als 10% nach dem Härten besitzt.

10. Verfahren nach einem der vorhergehenden Ansprüche, das die folgenden Schritte einschließt:

- Verwenden eines Materials, das eine flüssige, polymerisierbare Komponente als Abstandshaltermaterial enthält,
- Aufbringen des ungehärteten Abstandshaltermaterials auf die Oberfläche eines Elementes, ausgewählt aus der Gruppe, bestehend aus dem Originalstempel und dem Träger,
- nachfolgendes Anordnen des Originalstempels und des Trägers aufeinander und Härten des Abstandshaltermaterials, wodurch eine Zelle mit dem gehärteten Abstandshaltermaterial als Abstandshalter gebildet wird.

11. Verfahren nach Anspruch 1, worin ein Elastomer als Abstandshalter (3) für die Zelle verwendet wird.

12. Verfahren nach Anspruch 11, worin das Elastomer eine Härte von nicht mehr als 80 besitzt, bestimmt gemäß ASTM D2240 (JIS K6301).

13. Verfahren nach Anspruch 12, worin das Elastomer eine Härte von nicht mehr als 50 aufweist.

14. Verfahren nach Anspruch 11 oder Anspruch 12 , worin das Elastomer ein gehärtetes Produkt eines Materials ist, das eine flüssige, polymerisierbare Komponente enthält.

15. Verfahren nach einem der Ansprüche 11 bis 14, worin das Elastomer ein Siliconkautschuk ist.

16. Verfahren nach einem der Ansprüche 1 bis 10, worin ein Elastomer im Gelzustand als Abstandshalter für die Zelle verwendet wird.

17. Verfahren nach Anspruch 16, worin das Elastomer im Gelzustand ein Eindringungsvermögen von 10 bis 100×10^{-1} mm besitzt.

18. Verfahren nach Anspruch 17, worin das Elastomer im Gelzustand ein Eindringungsvermögen von 30 bis 100×10^{-1} mm besitzt.

19. Verfahren nach Anspruch 16, Anspruch 17 oder Anspruch 18, worin das Elastomer im Gelzustand ein gehärtetes Produkt eines Materials ist, das eine flüssige, polymerisierbare Komponente enthält.

20. Verfahren nach Anspruch 16, Anspruch 17 oder Anspruch 18, worin das Elastomer im Gelzustand ein Siliconkautschuk ist.

21. Verfahren nach einem der Ansprüche 1 bis 10, das die folgenden Schritte aufweist:

- Verwenden eines wärmeerweichenden Materials als Abstandshalter,
- Befüllen der Höhlung der Zelle mit dem wenigstens einen Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, und
- Härten des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der, polymerisierbaren Komponente und dem flüssigen Harz, in der Höhlung, wobei der Abstandshalter sich in einem erweichten Zustand befindet, in den er durch Erwärmen des Abstandshalters auf eine Temperatur, die höher liegt als die Erweichungstemperatur des Abstandshalters, verbracht wurde.

22. Verfahren nach Anspruch 21, worin das wärmeerweichende Material ein Material ist, das bei einer Temperatur, die um 10°C höher liegt als die Erweichungstemperatur des Materials, eine niedrigere Viskosität aufweist als die Viskosität des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz.

23. Verfahren nach Anspruch 21 oder Anspruch 22, worin das wärmeerweichende Material ein Wachs ist.

24. Verfahren nach einer der vorhergehenden Ansprüche, das den Schritt umfaßt, daß der Abstandshalter entfernt wird, nachdem die Höhlung mit dem wenigstens einen Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, gefüllt wurde und dann das wenigstens eine Material, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, gehärtet wurde.

25. Verfahren nach einem der Ansprüche 1 bis 9, worin der Abstandshalter ein Harzfilm ist.

26. Verfahren nach einem der vorhergehenden Ansprüche, worin das Harzformstück mit dem konkav-konvexen Muster ein Träger für ein optisches Aufzeichnungsmaterial ist.

27. Verfahren nach einem der vorhergehenden Ansprüche zur Verwendung bei der Herstellung einer Originalstempelplatte aus einem Originalstempel, der auf seiner Oberfläche ein konkav-konvexes Muster für die Stempelplatte enthält.

28. Verfahren nach Anspruch 27, worin die Stempelplatte scheibenförmig ist.

29. Verfahren nach Anspruch 27, worin die Stempelplatte kartenförmig ist.

30. Vorrichtung zur Herstellung eines Harzformteiles, die folgendes umfaßt:

- Eine Zelle mit einer Höhlung, die gebildet wird durch einen Originalstempel mit einem konkav-konvexen Muster auf der Oberfläche, einem Träger mit einer flachen Oberfläche und einem Abstandshalter, wobei die Oberfläche mit dem konkav-konvexen Muster und die flache Oberfläche durch den Abstandshalter so gehalten werden, daß die Flächen einander gegenüberliegen,
- eine Einrichtung zum Füllen des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, in die Höhlung, dadurch gekennzeichnet, daß die Einrichtung zum Füllen des wenigstens einen Materials, ausgewählt aus der Gruppe, bestehend aus der flüssigen, polymerisierbaren Komponente und dem flüssigen Harz, in die Höhlung eine Kammer umfaßt, in der die Zelle und die Flüssigkeiten untergebracht sind,
- eine Einrichtung zum Verringern des Druckes im Innern der Kammer und
- eine Einrichtung zum Versperren einer Einlaßöffnung der Zelle mit dem wenigstens einen Material, ausgewählt aus der Gruppe, bestehend aus den erwähnten Flüssigkeiten, und
- eine Einrichtung zum Ausgleichen des Zustandes des verringerten Druckes im Innern der Kammer.

31. Vorrichtung nach Anspruch 30, worin der Abstandshalter ein Elastomer ist.

32. Vorrichtung nach Anspruch 31, worin das Elastomer eine Härte von nicht mehr als 80 besitzt, bestimmt gemäß ASTM D2240 (JIS K6301).

33. Vorrichtung nach Anspruch 31 oder Anspruch 32, worin das Elastomer ein Siliconkautschuk ist.

34. Vorrichtung nach Anspruch 30, worin der Abstandshalter ein Elastomer im Gelzustand ist.

35. Vorrichtung nach Anspruch 34, worin das Elastomer im Gelzustand ein Eindringungsvermögen von 10 bis 100×10^{-1} mm besitzt.

36. Vorrichtung nach Anspruch 34 oder Anspruch 35, worin das Elastomer im Gelzustand ein Siliconkautschuk ist.

Revendications

1. Procédé destiné à produire un moulage de résine ayant un relief concave-convexe sur la surface, qui comprend les étapes consistant à :

(a) fournir une matrice (1) originale ayant un relief concave-convexe (1') sur la surface et un substrat (4) ayant une surface plate, positionner la surface de relief concave-convexe et la surface plate à l'opposé l'une de l'autre au niveau d'une séparation définie par un intercalaire (3), formant ainsi une cellule (4) avec une cavité (17) formée par la matrice originale, le substrat et l'intercalaire,
(b) remplir la cavité (17) avec au moins l'un ou l'autre d'un composant polymérisable liquide et de la résine liquide,
(c) durcir au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide dans la cavité (17) afin de former une réplique du relief (1'), et
(d) détacher la matrice originale (1) de la réplique afin d'obtenir un moulage de résine, caractérisé en ce que
(e) ladite étape de remplissage de la cavité (17) avec au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide, est réalisée en disposant la cellule (4) et au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide à l'intérieur d'une chambre (6) ayant des moyens (7, 8) destinés à contrôler la pression interne,
(f) après avoir réduit la pression interne dans la chambre (6), obturer un orifice d'admission (5) de la cellule avec au moins l'un ou l'autre du composant polymérisable liquide non durci et de la résine liquide non durcie, et ensuite,
(g) laisser la pression augmenter à l'intérieur de la chambre (6).

2. Procédé selon la revendication 1, dans lequel, à l'étape (f), la pression interne de la cavité est fixée de $1/10^2$ à $1/10^4$ de la pression externe.

3. Procédé selon la revendication 2, dans lequel, à l'étape (f), la pression interne de la cavité est fixée de $1/10^2$ à $1/10^3$ de la pression externe.

4. Procédé selon la revendication 1, dans lequel, à l'étape (f), la pression interne de la cavité n'excède pas 1 torr.

5. Procédé selon la revendication 4, dans lequel, à l'étape (f), la pression interne de la cavité n'excède pas 0,1 torr.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide devant être injecté dans la cavité a une viscosité n'excédant pas 10^4 cps.

7. Procédé selon la revendication 6, dans lequel au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide a une viscosité allant de 10^2 à 10^3 cps.

8. Procédé selon la revendication 6 ou 7, dans lequel le composant polymérisable liquide est une résine photodurcissable non durcie.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide a un rétrécissement en volume n'excédant pas 10 % après durcissement.

10. Procédé selon l'une quelconque des revendications précédentes, qui comprend les étapes consistant à utiliser un matériau contenant un composant polymérisable liquide en tant que matériau intercalaire, appliquer le matériau intercalaire non durci à la surface d'au moins l'un ou l'autre de la matrice originale et du substrat, placer ensuite la matrice originale et le substrat l'un sur l'autre et durcir le matériau intercalaire, formant ainsi une cellule avec le matériau intercalaire durci en tant qu'intercalaire.

11. Procédé selon la revendication 1, dans lequel un élastomère est utilisé en tant qu'intercalaire (3) pour la cellule.

12. Procédé selon la revendication 11, dans lequel l'élastomère a une dureté n'excédant pas 80 déterminée par ASTM D2240 (JIS K6301).

13. Procédé selon la revendication 12, dans lequel l'élastomère a une dureté n'excédant pas 50.

14. Procédé selon la revendication 11 ou 12, dans lequel l'élastomère est un produit durci d'un matériau contenant un composant polymérisable liquide.

15. Procédé selon l'une quelconque des revendications 11 à 14, dans lequel l'élastomère est un caoutchouc silicone.

16. Procédé selon l'une quelconque des revendications 1 à 10, dans lequel un élastomère à l'état de gel est utilisé en tant qu'intercalaire pour la cellule.

17. Procédé selon la revendication 16, dans lequel l'élastomère à l'état de gel a une pénétration de 10 à 100 x 10^{-1} mm.

18. Procédé selon la revendication 17, dans lequel l'élastomère à l'état de gel a une pénétration de 30 à 100 x 10^{-1} mm.

19. Procédé selon la revendication 16, 17 ou 18, dans lequel l'élastomère à l'état de gel est un produit durci d'un matériau contenant un composant polymérisable liquide.

20. Procédé selon la revendication 16, 17 ou 18, dans lequel l'élastomère à l'état de gel est un caoutchouc silicone.

21. Procédé selon l'une quelconque des revendications 1 à 10, qui comprend une étape consistant à utiliser un matériau à ramollissement par la chaleur en tant qu'intercalaire, remplir la cavité de la cellule avec au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide et durcir au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide dans la cavité dans un état ramolli de l'intercalaire obtenu en chauffant l'intercalaire à une température supérieure à la température de ramollissement de l'intercalaire.

22. Procédé selon la revendication 21, dans lequel le matériau à ramollissement par la chaleur est un matériau ayant une viscosité inférieure, à une température de 10 °C supérieure à la température de ramollissement du matériau, à la viscosité d'au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide.

23. Procédé selon la revendication 21 ou 22, dans lequel le matériau à ramollissement par la chaleur est de la cire.

24. Procédé selon l'une quelconque des revendications précédentes, qui comprend l'étape consistant à retirer l'intercalaire après que la cavité a été remplie avec au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide et ensuite, que celui parmi au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide a durci.

25. Procédé selon l'une quelconque des revendications 1 à 9, dans lequel l'intercalaire est une pellicule de résine.

26. Procédé selon l'une quelconque des revendications précédentes, dans lequel le moulage de résine ayant un relief concave-convexe est un substrat destiné à un support d'enregistrement optique.

27. Procédé selon l'une quelconque des revendications précédentes, lorsqu'il est utilisé pour fabriquer une plaque de matrice de pressage originale à partir d'une matrice originale ayant sur sa surface un relief concave-convexe pour ladite plaque de matrice de pressage.

28. Procédé selon la revendication 27, dans lequel la plaque de matrice de pressage est en forme de disque.

29. Procédé selon la revendication 27, dans lequel la plaque de matrice de pressage est en forme de carte.

30. Appareil destiné à produire un moulage de résine qui comprend

une cellule comportant une cavité formée par une matrice originale ayant un relief concave-convexe sur la surface, un substrat ayant une surface plate et un intercalaire, la surface à relief concave-convexe et la surface plate étant supportées en relation de vis-à-vis à travers l'intercalaire,

des moyens destinés à injecter au moins l'un ou l'autre d'un composant polymérisable liquide et d'une résine liquide dans la cavité, caractérisé en ce que

lesdits moyens destinés à injecter au moins l'un ou l'autre du composant polymérisable liquide et de la résine liquide dans la cavité comprennent une chambre dans laquelle la cellule et lesdits liquides sont placés,

des moyens sont prévus pour réduire la pression à l'intérieur de la chambre,

des moyens sont prévus pour obturer un orifice d'admission de la cellule avec au moins l'un des deux liquides, et

des moyens sont prévus pour relâcher un état de pression réduite à l'intérieur de la chambre.

31. Appareil selon la revendication 30, dans lequel l'intercalaire est un élastomère.

32. Appareil selon la revendication 31, dans lequel l'élastomère a une dureté n'excédant pas 80 déterminée par ASTM D2240 (JIS K6301).

33. Appareil selon la revendication 31 ou 32, dans lequel l'élastomère est un caoutchouc silicone.

34. Appareil selon la revendication 30, dans lequel l'intercalaire est un élastomère à l'état de gel.

35. Appareil selon la revendication 34, dans lequel l'élastomère à l'état de gel a une pénétration de 10 à 100 x 10^{-1} mm.

36. Appareil selon la revendication 34 ou 35, dans lequel l'élastomère à l'état de gel est un caoutchouc silicone.

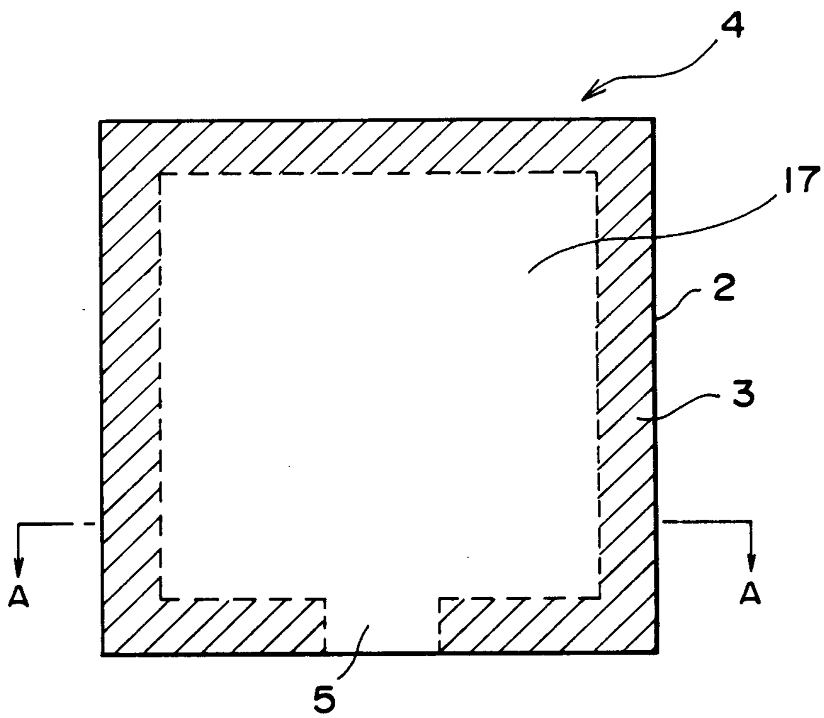

FIG. 1A

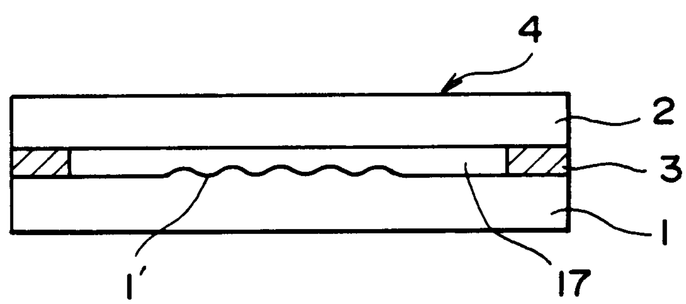

FIG. 1B

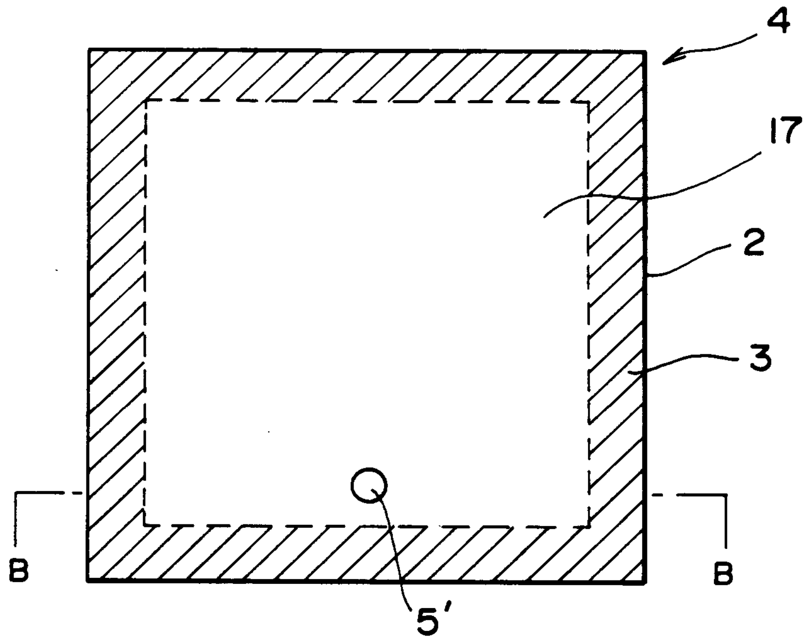

FIG. 2A

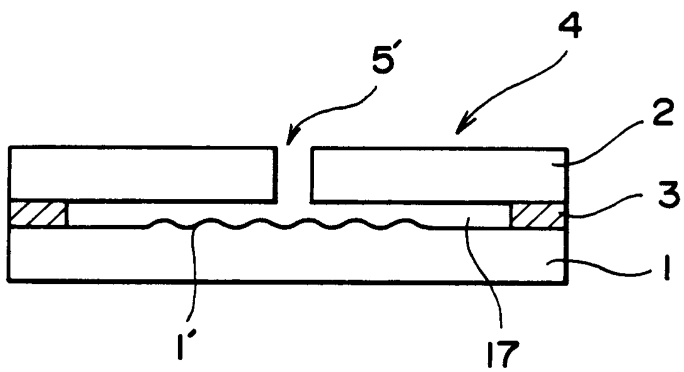

FIG. 2B

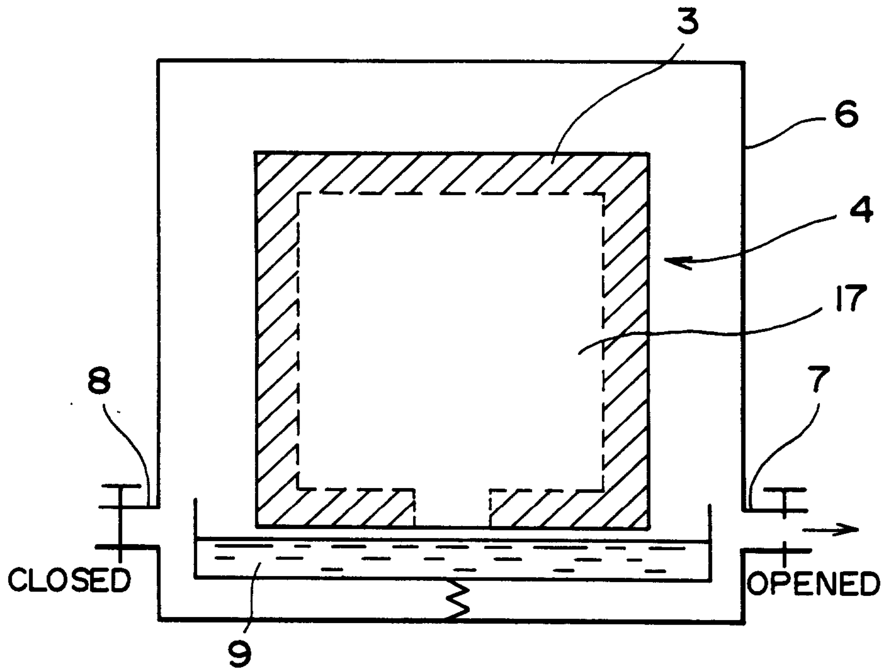

FIG. 3A

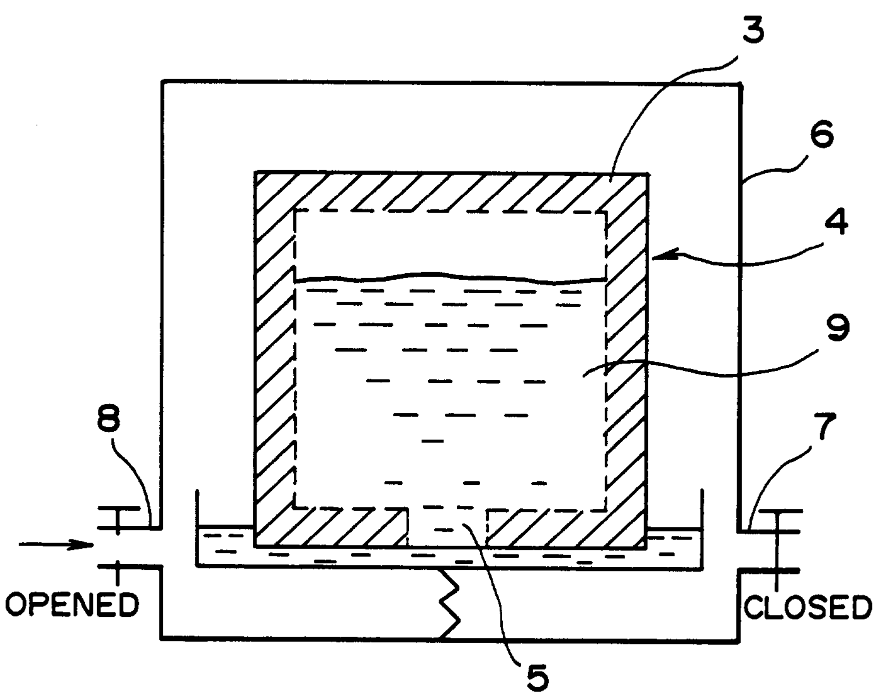

FIG. 3B

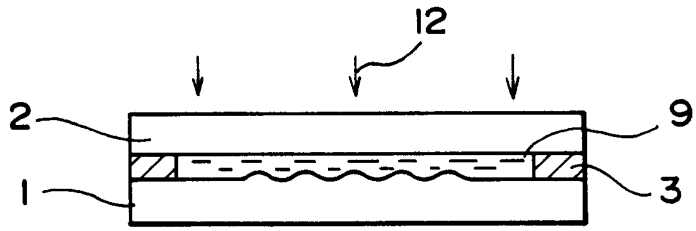

FIG. 4A

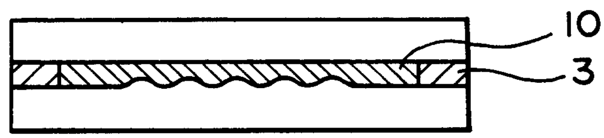

FIG. 4B

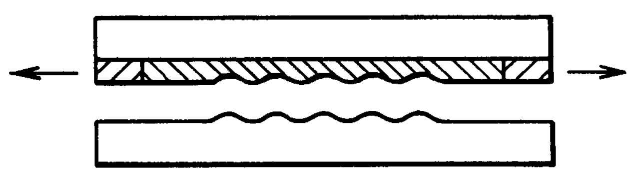

FIG. 4C

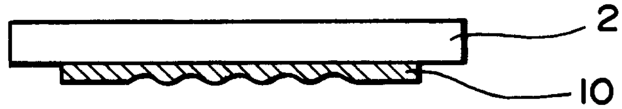

FIG. 4D

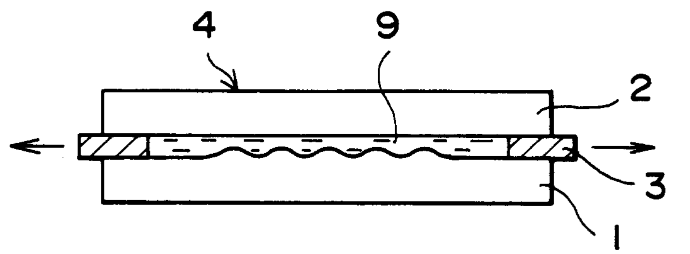

FIG. 5A

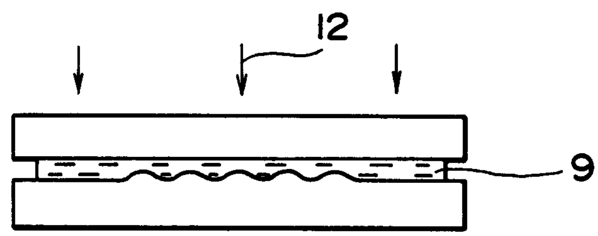

FIG. 5B

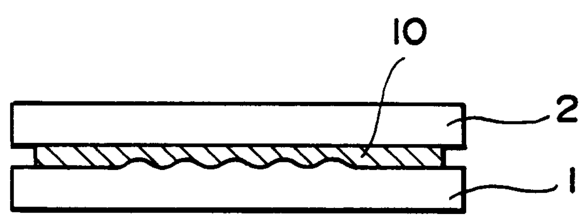

FIG. 5C

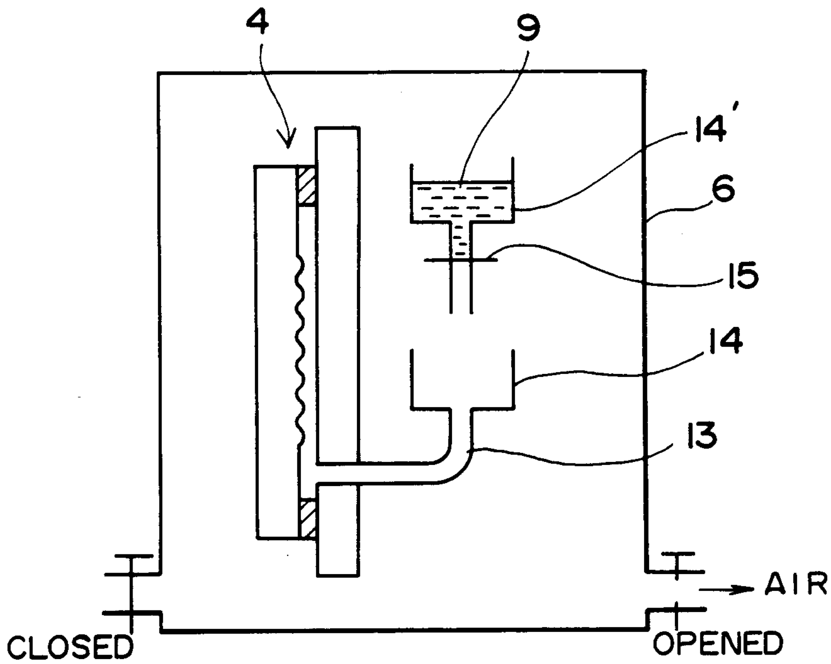

FIG. 6A

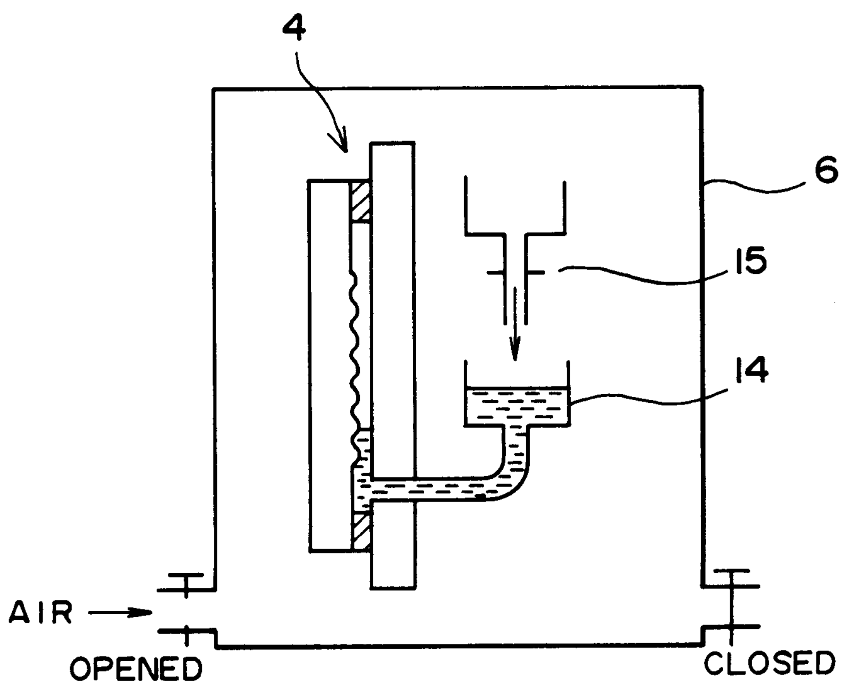

FIG. 6B

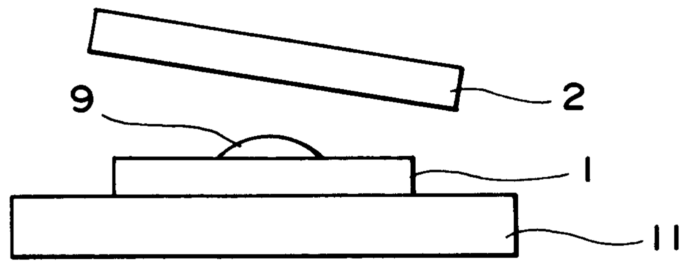

FIG. 7A

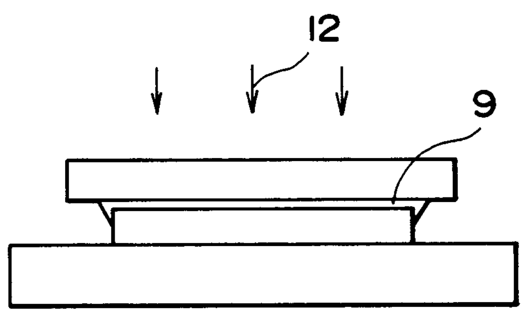

FIG. 7B

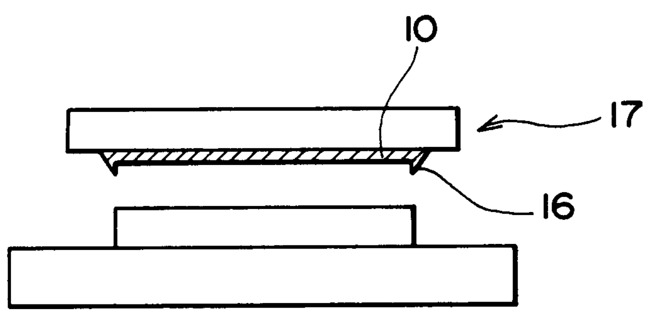

FIG. 7C